MARKET 3 — COMMERCIAL AND INDUSTRIAL LIGHTING REMODELING AND REPLACEMENT UPGRADES

Market Scope

This market comprises upgrades to lighting systems in existing buildings at the time of remodel or natural replacement, including upgrades from standard T8 fluorescent fixtures to super T8 or T5 fixtures, replacing incandescent fixtures with hard-wired compact fluorescent fixtures, replacing incandescent or fluorescent exit signs with LED exit signs, replacing high bay HID fixtures with fluorescent high bay fixtures, and installing occupancy sensors in offices, classrooms, restrooms, and break rooms. This market addresses savings and costs for end-users who need to make a lighting upgrade (regardless of program intervention) because of system age, failures, or remodeling, but may not upgrade to the most efficient system available. End-users retrofitting their existing equipment, acting primarily for the purpose of lowering energy bills after motivation by the program intervention, are addressed through Market 5, Lighting and Lighting Controls Retrofit. The savings and costs of Markets 3 and 5 are additive, because they target different segments of the market.

Market Characteristics

Lighting is the primary electric end use in commercial buildings, accounting for over 45% of total electric consumption in commercial buildings (WPS/McGraw Hill, 2004). Fluorescent fixtures make up the majority of lighting in commercial buildings and, according to a report completed by KEMA, Inc. (2005), over 56% of total installed commercial fluorescent stock is made up of standard T8 fixtures with electronic ballasts, and nearly 90% of contractor installations involve T8 fixtures, super T8 fixtures, or T5 fixtures. This suggests that end-users in the market for lighting will choose to install standard T8 fixtures without outside program intervention. The existing stock of exit signs and incandescent application fixtures is also fairly heavily comprised of the energy efficient alternatives. Over 43% of incandescent application fixtures (wall sconces, task lighting, etc.) are compact fluorescent, and over 48% of exit signs are LED exit signs.

Occupancy sensors save between 47% and 60% in restrooms and between 17% and 29% in break rooms. Unfortunately, restrooms and break rooms are a relatively minor percentage of floor space in commercial and industrial buildings (Von Neida). Occupancy sensors in offices and classrooms are more modest at 6% to 13% in office areas and 10% to 19% in classrooms (Von Neida).

Program Approaches

Our analysis of this market considered these program efforts:

- increase the market adoption of lighting alternatives such as super T8 and T5 fixtures that are more efficient than currently installed standard T8 fluorescent or HID fixtures.
- increase the market adoption of LED exit signs and compact fluorescent fixtures.
- increase the market adoption of occupancy sensors.

Lighting remodeling and replacement programs are targeted at customer segments that ultimately replace and upgrade lighting systems because they no longer provide the quality or reliability required in the space. There is some opportunity for design improvements in spaces that allow moving or reducing the number of lighting fixtures as part of a remodel.

PROGRAM AREA 3.01 — INCENTIVES FOR COMMERCIAL AND INDUSTRIAL LIGHTING REMODELING AND REPLACEMENT UPGRADES

Our analysis of the achievable potential for this program area is projected from upgrade (incremental cost) incentive levels for high efficiency lighting options such as super T8 and T5 fixtures, while eliminating incentives entirely for standard T8 fixtures. We assumed that 67% of lighting falls into the incremental lighting upgrades of Market 3, while the remaining 33% of lighting energy is addressed by the retrofits targeted by Market 5.

TABLE 1. MIDPOINT ESTIMATES OF PROGRAM COSTS AND IMPACTS FOR PROGRAM AREA 33.01, INCENTIVES FOR COMMERCIAL AND INDUSTRIAL LIGHTING REMODELING AND REPLACEMENT UPGRADES

Year	Program Costs ($000s)	Incremental First-Year Impacts		
		Peak kW	Annual kWh (000s)	Annual therms (000s)
1	$5,724	9,274	46,973	-707
2	$6,827	11,129	56,368	-848
3	$7,930	12,983	65,762	-990
4	$8,953	14,838	75,157	-1,131
5	$11,159	18,548	93,946	-1,414
6	$11,159	18,548	93,946	-1,414
7	$11,159	18,548	93,946	-1,414
8	$11,159	18,548	93,946	-1,414
9	$11,159	18,548	93,946	-1,414
10	$11,159	18,548	93,946	-1,414

(TECHNICAL DOCUMENTATION)

Below, we document the technical assumptions we made for the lighting energy savings in the commercial and industrial lighting remodeling and replacement upgrades market.

Program Area 3.01 — Incentives for Commercial and Industrial Lighting Remodeling and Replacements Upgrades

Model inputs for this program area are summarized in the table below, and described on the following pages.

Model Inputs (03.01)		Value	±
1	**Impacts**		
a	2005 market size (GWh)	12,001	1,200
b	2005 market size (peak MW)	2,369	237
c	2005 market size (10^12 Btu)	0	0
d	Annual market growth rate (2006-2015)	2.9%	0.2%
e	Nat gas increase from electric savings (therms/MWh-saved)	15	4
	Efficiency improvement within 2006 inventory w/o program intervention		
f	Annual market undergoing improvements (2006-2015)	6.7%	1.4%
g	Electric energy % saved within failed systems	9.0%	1.8%
h	Electric peak demand % saved within failed systems	9.0%	1.8%
	Identified savings potential for primary intervention within replacement inventory as of 1/1/2006		
i	Annual market for intervention (2006-2015)	6.7%	1.4%
j	Electric energy % savings (normal replacements)	15.1%	3.0%
k	Electric peak demand % savings (normal replacements)	15.1%	3.0%
l	Electric energy % savings (accelerated replacements)	0.0%	0.0%
m	Electric peak demand % savings (accelerated replacements)	0.0%	0.0%
	Identified savings potential for add-on intervention within inventory as of 1/1/2006		
n	Annual market for intervention (2006-2015)	6.7%	1.4%
o	Electric energy % savings	4.9%	1.0%
p	Electric peak demand % savings	4.9%	1.0%
q	Natural gas energy % savings	0.0%	0.0%
	Identified savings potential in new usage with primary intervention		
r	Electric energy % savings	0.0%	0%
s	Electric peak demand % savings	0.0%	0%
t	Natural gas energy % savings	0.0%	0%
2	**Program Participation**		
	Primary intervention for 2006 existing		
a	Participation in Year 1 (% of 2006 replaced inventory)	30%	

	b	Ultimate annual participation rate (% of replaced inventory)	60%	10%
	c	Year ultimate participation reached	5	
	d	Net-to-gross ratio for primary intervention	0.98	0.02
	Add-on intervention for 2006 existing			
	e	Participation in Year 1 (% of 2006 replaced inventory)	30%	
	f	Ultimate annual participation rate (% of replaced inventory)	60%	10%
	g	Year ultimate participation reached	5	
	h	Net-to-gross ratio for add-on component	0.98	0.02
	Primary intervention for new usage			
	i	Participation in Year 1 (% of annual new usage)	0%	
	j	Ultimate annual participation rate (% of annual new usage)	0%	10%
	k	Year ultimate participation reached	0	
	l	Net-to-gross ratio for primary intervention	0.00	0.00
3		**Program costs**		
	a	Administration start up cost premium (total over years 1 - 3)	$240,000	
	b	Base administrative costs (% of all intervention costs)	7%	
	Primary intervention for 2006 existing			
	c	Additional costs above variable costs for intervention (annual)	$70,000	
	d	Market management and field staff (% of variable costs)	20%	
	e	Incentive costs per annual kWh saved	$0.06	
	f	Incentive costs per peak kW reduced	$150	
	Add-on intervention for 2006 existing			
	g	Additional costs above variable costs for intervention (annual)	$50,000	
	h	Market management and field staff (% of variable costs)	20%	
	i	Incentive costs per annual kWh saved	$0.06	
	j	Incentive costs per peak kW reduced	$150	
	Primary intervention for new usage			
	k	Additional costs above variable costs for intervention (annual)	$0	
	l	Market management and field staff (% of variable costs)	0%	
	m	Incentive costs per annual kWh saved	$0.00	
	n	Incentive costs per peak kW reduced	$0	
4		**Measure life (years)**	15	3

1. Per Unit Impacts

Lighting is the primary electric end use in commercial buildings, accounting for over 45% of total electric consumption in commercial buildings (WPS/McGraw Hill, 2004). The size of the lighting market in Wisconsin was estimated by first using data from a WPS/McGraw Hill survey (2004) to break out lighting from other end uses in various commercial building types in Heating and Cooling Zone 1. Percentages of electric use commercial building type were obtained from a Focus on Energy baseline market research study (XENERGY, 2002). These values were then scaled to an estimated level for 2005

(10,007 GWh) based on PSC-Wisconsin commercial electric forecast data for 2004-2015 (PSC, 2004 and Kliebenstein, 2005).

In contrast, lighting is a fairly minor end use in the industrial sector based on total consumption, making up under 8%, or approximately 1,959 GWh in 2005 (EIA, 2005). It is assumed that high bay fixtures make up a significantly higher percentage of fixtures in Wisconsin industrial facilities than in commercial facilities (Navigant, 2002).

Impact on natural gas use for heating was estimated to be 75% of the lighting energy savings, for a six month period, and assuming an 85% efficient heating system; this results in an additional space heating requirement of 15 Therms per lighting MWh saved.

Installed base lighting average wattage was determined using an estimated percentage of high efficiency fixture saturation versus standard efficiency options.

Fluorescent fixtures – T8 fixtures are estimated to comprise 56.7% of existing fluorescent fixtures (KEMA, 2005). T12 34 W fixtures are assumed to make up 30% of existing fixtures and T12 40 W fixtures are assumed to make up 13.3%. Base fixture wattages are assumed to be 2-lamp fixtures. T8 fixture wattage is estimated to be 62 W, T12 34 W fixture with energy saving ballast is assumed to be 66 W, and 40 W T12 fixture with magnetic ballast is assumed to be 88 W (Xcel Energy). The weighted average base fixture wattage is then 66.7 W.

Incandescent application fixtures – CFL bulbs or fixtures are estimated to comprise 43.6% of incandescent application fixtures, with 56.4% being incandescent or halogen (KEMA, 2005). CFL wattage is assumed to be 25 W while incandescent wattage is assumed to be 60 W (Xcel Energy). The weighted average base incandescent application fixture wattage is then 42.6 W.

High bay fixtures – High bay fluorescent fixtures are assumed to comprise less than 10% of the high bay fixture market, with the remainder being HID fixtures. HID wattage is assumed to be 460 W including ballast, while high bay fluorescent wattage is assumed to be 270 W (Xcel Energy). The weighted base high bay fixture wattage is then 441.8 W.

Exit signs – LED exit signs are estimated to comprise 48.3% of the exit sign market (KEMA, 2005). Fluorescent exit signs are estimated to be 35% of the market and incandescent exit signs are estimated to be 16.7% of the market. LED exit sign wattage is assumed to be 4 W, fluorescent exit sign wattage is assumed to be 26 W, and incandescent exit sign wattage is assumed to be 40 W (Xcel Energy). The weighted base exit sign wattage is then 17.7 W.

Naturally occurring current practice replacement wattages are estimated as follows:

Fluorescent fixtures – T8 fixtures are estimated to comprise 87% of replacement fluorescent fixtures (KEMA, 2005). T12 34 W fixtures are assumed to make up 2% of existing fixtures and super T8 or T5 fixtures are assumed to make up 11%. Base fixture wattages are assumed to be 2-lamp fixtures. T8 fixture wattage is estimated to be 62 W, T12 34 W fixture with energy saving ballast is assumed to be 66 W, and super T8 or T5 wattage is assumed to be 54 W (Xcel Energy). The weighted average base fixture wattage is then 61.2 W, resulting in 8.1% savings over base.

Incandescent application fixtures – CFL bulbs or fixtures are estimated to comprise 60% of incandescent application fixtures, with 40% being incandescent or halogen (KEMA, 2005). CFL wattage is assumed to be 25 W while incandescent wattage is assumed to be 60 W (Xcel Energy). The weighted average base incandescent application fixture wattage is then 39 W, for an 8.4% savings over base.

High bay fixtures – High bay fluorescent fixtures are assumed to comprise 34% of high bay fixture installations, with the remainder being HID fixtures. HID wattage is assumed to be 460 W including ballast, while high bay fluorescent wattage is assumed to be 270 W (Xcel Energy). The weighted base high bay fixture wattage is then 395.4 W, for a 10.5% savings over base.

Exit signs – LED exit signs are estimated to comprise 90% of exit sign installations (KEMA, 2005). Fluorescent exit signs are estimated to be 10% of the market and incandescent exit signs are estimated to be 0% of the market. LED exit sign wattage is assumed to be 4 W, fluorescent exit sign wattage is assumed to be 26 W, and incandescent exit sign wattage is assumed to be 40 W (Xcel Energy). The weighted base exit sign wattage is then 6.2 W, for a 65% savings over base.

Overall standard practice replacement savings based on estimated fixture type installation proportions of total lighting electric sales (73.9% fluorescent tube, 13.4% incandescent application, 11.7% high bay, and 1.0% exit sign) is 9.0%.

Program wattages are as follows:

Fluorescent fixtures – Only super T8 and T5 fixtures would be eligible for incentives. Super T8 or T5 wattage is assumed to be 54 W (Xcel Energy). The weighted average base fixture wattage is then 54 W, resulting in 11.8% savings over standard practice installations.

Incandescent application fixtures – Only hard wired CFL fixtures would be eligible for incentives. CFL wattage is assumed to be 25 W (Xcel Energy). The weighted average base incandescent application fixture wattage is then 25 W, for a 25.1% savings over standard installation. It is also assumed that CFL fixtures would only be applicable in 70% of installations. Inappropriate installations would include certain retail applications and galleries where halogen is used exclusively for ideal color rendering.

High bay fixtures – Only high bay fluorescent fixtures would be eligible for incentives. High bay fluorescent wattage is assumed to be 270 W (Xcel Energy). The weighted base high bay fixture wattage is then 270 W, for a 22.2% savings over standard practice. It is also assumed that high bay fluorescent fixtures would only be applicable in 70% of installations. Inappropriate installations would include low temperature applications in which lumen output would be dramatically reduced.

Exit signs – Only LED exit signs would be eligible for incentives (KEMA, 2005). LED exit sign wattage is assumed to be 4 W (Xcel Energy). The weighted base exit sign wattage is then 4 W, for a 35.5% savings over base.

Overall savings based on estimated fixture type relative to base installation proportions of total lighting electric sales (73.9% fluorescent tube, 13.4% incandescent application, 11.7% high bay, and 1.0% exit sign) is 15.1%.

Lighting remodeling and replacement upgrade program savings is the difference between the standard replacement practice wattage and program wattage, or 15.1%.

Additional system improvements, described as an Add-On Component in the model input table included occupancy sensors. Occupancy sensors are estimated to result in an average of 4.9% savings from total electric lighting sales based on savings of 9% for offices, 53.5% for restrooms, 23% for break rooms, and 14.5% for classrooms (Von Neida) and an estimated floors space percentage for each of those space types.

2. Program Participation

The interventions have been modeled to achieve an aggressive but cost effective participation rate. The program is assumed to target customer segments that ultimately replace and upgrade lighting systems because they no longer provide the quality or reliability required in the space. The target market for incremental upgrades is assumed to be 67% of the total lighting market opportunity that exists as of January 1, 2006.

Program participation for lighting upgrades begins at 30% in year one based on the fact that there is a long history of intervention in the lighting market, compared with other markets. Peak participation was estimated to ramp up to 60% by Year 5. Participation is capped at these levels, assuming that program incentives would not influence all building owners to upgrade to the highest efficiency lighting or improve their systems with add-on control measures.

The net to gross ratio is assumed to be 0.98 with an uncertainty of 0.02 (Quantum, 2004).

3. Program Costs

Program costs reflect planning assumptions consistent with the high level of participation. Start up costs of $240,000 over three years ($80,000 per year) are allocated to achieve an aggressive statewide effort, filling gaps in areas such as market research, information and outreach, demonstration projects, tools, and case studies. A general administrative cost of 7% of all intervention costs provides funding for management of the overall market effort, program specific tracking and reporting, planning meetings, and other expenses.

Costs for each intervention in the market are broken into three categories:

- incentives for participants, lighting designers, suppliers, and other program allies;
- a market manager to handle day-to-day responsibilities and field staff to work with participants on specific projects; and
- annual fixed costs for activities such as training, product and service development (tools, manuals, guides, software, etc.).

Incentives are paid for electric energy and demand savings. The overall incentive pool may be provided as participant rebates, designer incentives, supplier rebates, on-site evaluations, or other project specific costs to influence participation. The incentive costs for this intervention were intended to cover approximately 75% to 100% of incremental measure costs.

4. Measure Life

A measure life of 15 years was used in the lighting input model with an uncertainty of plus/minus 3 years (Quantum, 2004).

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